WHAT IS CLAIMED AS NEW AND DESIRED TO BE SECURED BY LETTERS PATENT OF THE UNITED STATES IS:

1. A heat exchange apparatus comprising:

a housing;

a first array of fluid conduits provided within said housing, said first array of fluid conduits being configured to carry a first fluid;

a second array of fluid conduits provided within said housing, said second array of fluid conduits being configured to carry the first fluid; and

a first fluid passageway provided within said housing, said first fluid passageway being defined by an internal surface of said housing and by a baffle plate, said first fluid passageway being configured to carry a second fluid,

wherein said baffle plate is configured to divide said first fluid passageway into a first flow path and a second flow path, and

wherein said first array of fluid conduits extends through said first flow path and said second array of fluid conduits extends through said second flow path.

2. The heat exchange apparatus according to Claim 1, wherein said first fluid passageway includes an inlet and an outlet, and wherein said outlet is provided at a location vertically above said inlet.

3. The heat exchange apparatus according to Claim 1, wherein said first fluid passageway includes an inlet, a first outlet, and a second outlet, wherein said first outlet is connected to said first flow path and said second outlet is connected to said second flow path, and wherein said first outlet and said second outlet are provided at a location vertically above said inlet.

4. The heat exchange apparatus according to Claim 1, further comprising a

preheater section having an additional fluid passageway fluidly connected to an outlet of said first fluid passageway, wherein said preheater section includes a fluid conduit extending through said additional fluid passageway, wherein said fluid conduit is configured to carry the first fluid, and wherein said fluid conduit is fluidly connected to an inlet manifold fluidly connected to said first array of fluid conduits and said second array of fluid conduits.

5. The heat exchange apparatus according to Claim 4, wherein said outlet of said first fluid passageway is connected to said additional fluid passageway by a fluid sealing joint configured to accommodate differential expansion.

6. The heat exchange apparatus according to Claim 5, wherein said fluid sealing joint is a slip joint.

7. The heat exchange apparatus according to Claim 5, wherein said fluid sealing joint is a fabric or metal bellows.

8. The heat exchange apparatus according to Claim 4, further comprising a boiler section having a boiler provided along said fluid conduit between said preheater section and said inlet manifold, wherein said additional fluid passageway extends through said boiler section, and wherein said boiler extends through said additional fluid passageway at a location between said preheater and said outlet of said first fluid passageway.

9. The heat exchange apparatus according to Claim 8, further comprising a superheater section, wherein said additional fluid passageway extends through said superheater section, and wherein said fluid conduit extends through said additional passageway at a location between said boiler section and said outlet of said first fluid passageway.

10. The heat exchange apparatus according to Claim 9, wherein said superheater section is provided at a location vertically above said outlet of said first fluid passageway,

wherein said boiler section is provided at a location vertically above said superheater section, and wherein said preheater section is provided at a location vertically above said boiler section.

11. The heat exchange apparatus according to Claim 10, wherein said first fluid passageway includes an inlet, and wherein said outlet of said first fluid passageway is provided at a location vertically above said inlet.

12. The heat exchange apparatus according to Claim 11, further comprising an exhaust fan provided at an outlet of said additional fluid passageway.

13. The heat exchange apparatus according to Claim 10, wherein said first fluid passageway includes an inlet, a first outlet, and a second outlet, wherein said first outlet is connected to said first flow path and said second outlet is connected to said second flow path, and wherein said first outlet and said second outlet are provided at a location vertically above said inlet.

14. The heat exchange apparatus according to Claim 13, further comprising an exhaust fan provided at an outlet of said additional fluid passageway.

15. The heat exchange apparatus according to Claim 10, further comprising:

a first container; and

a second container configured to be stacked on top of said first container,

wherein said housing is defined as a bottom module,

wherein said superheater section, said boiler section, and said preheater section are defined as a top module,

wherein said bottom module is housed within said first container,

wherein said top module is housed within said second container, and

wherein when said second container is stacked on top of said first container, then

said outlet of said first fluid passageway is connected to said additional fluid passageway.

16. The heat exchange apparatus according to Claim 1, wherein said first array of fluid conduits extend through said baffle plate, and wherein said second array of fluid conduits extend through said baffle plate.

17. The heat exchange apparatus according to Claim 1,

wherein said first array of fluid conduits having a first plurality of heat transfer fins provided on outer surfaces of said fluid conduits thereof, said first plurality of heat transfer fins extending within said first flow path, and

wherein said second array of fluid conduits having a second plurality of heat transfer fins provided on outer surfaces of said fluid conduits thereof, said second plurality of heat transfer fins extending within said second flow path.

18. The heat exchange apparatus according to Claim 1,

wherein said first array of fluid conduits includes a first row of fluid conduits, said first row of fluid conduits being fluidly connected to a first tubular inlet manifold and a first tubular outlet manifold, said first row of fluid conduits having a first heat transfer fin provided on outer surfaces thereof, said first heat transfer fin extending within said first flow path, and

wherein said first array of fluid conduits includes a second row of fluid conduits, said second row of fluid conduits being fluidly connected to a second tubular inlet manifold and a second tubular outlet manifold, said second row of fluid conduits having a second heat transfer fin provided on outer surfaces thereof, said second heat transfer fin extending within said first flow path.

19. The heat exchange apparatus according to Claim 1, wherein said first array of fluid conduits includes a first row of fluid conduits and a second row of fluid conduits, said

first row of fluid conduits and said second row of fluid conduits being fluidly connected to a tubular inlet manifold.

20. The heat exchange apparatus according to Claim 1, wherein said first array of fluid conduits includes a first row of fluid conduits and a second row of fluid conduits, said first row of fluid conduits and said second row of fluid conduits being fluidly connected to a tubular outlet manifold.

21. The heat exchange apparatus according to Claim 1, further comprising a sealing zone configured to define said first fluid passageway and a second fluid passageway within said housing.

22. The heat exchange apparatus according to Claim 21, wherein said sealing zone comprises:

said baffle plate extending across an entire cross section of said housing;

an additional baffle plate extending across an entire cross section of said housing and defining said second fluid passageway;

a refractory gasket provided between said baffle plate and said additional baffle plate; and

a layer of intumescent material provided between said baffle plate and said additional baffle plate,

wherein said first array of fluid conduits and said second array of fluid conduits extend through said baffle plate, said additional baffle plate, said refractory gasket, and said layer of intumescent material.

23. The heat exchange apparatus according to Claim 22, wherein said refractory gasket and said layer of intumescent material substantially entirely fill a gap between said baffle plate and said additional baffle plate.

24. The heat exchange apparatus according to Claim 22, wherein said layer of intumescent material is made of a material that expands at a temperature above about 300° C.

25. The heat exchange apparatus according to Claim 21, further comprising:

an additional fluid passageway connecting an outlet of said first fluid passageway and an inlet of said second fluid passageway; and

a burner provided along said additional passageway, said burner being configured to heat the second fluid entering said inlet of said second fluid passageway.

26. The heat exchange apparatus according to Claim 25, further comprising:

a preheater having an inlet fluid passageway fluidly connected to an inlet of said first fluid passageway, wherein said preheater includes a fluid conduit extending through said inlet fluid passageway, wherein said fluid conduit is configured to carry the first fluid, and wherein said fluid conduit is fluidly connected to an outlet manifold fluidly connected to said first array of fluid conduits and said second array of fluid conduits;

a cold combustion inlet fluidly connected to said inlet fluid passageway, wherein said cold combustion inlet is fluidly connected to said additional passageway at a location upstream of said burner; and

means for controlling a flow of the second fluid from said cold combustion inlet to said preheater and from said cold combustion inlet to said burner.

27. The heat exchange apparatus according to Claim 26, wherein said means for controlling comprises:

a first valve provided between said cold combustion inlet and said preheater to control a flow of the second fluid from said cold combustion inlet to said preheater; and

a second valve provided between said cold combustion inlet and said burner to control a flow of the second fluid from said cold combustion inlet to said burner.

28. The heat exchange apparatus according to Claim 26, further comprising an actuator configured to drive a control linkage connected to said first valve and said second valve to control said first valve and said second valve.

29. The heat exchange apparatus according to Claim 26, further comprising a first actuator configured to control said first valve and a second actuator configured to control said second valve.

30. The heat exchange apparatus according to Claim 26, wherein said means for controlling comprises a valve configured to continuously modulate flow between said cold combustion inlet and said preheater, and flow between said cold combustion inlet and said burner.

31. The heat exchange apparatus according to Claim 26, wherein said means for controlling comprises:

a first pipe connecting said cold combustion inlet to said preheater;

a second pipe connecting said cold combustion inlet to said burner; and

a valve configured to modulate flow,

wherein said valve is provided in one of said first pipe and said second pipe, and

wherein another of said first pipe and said second pipe does not have a valve therein.

32. The heat exchange apparatus according to Claim 1, wherein fluid conduits of said first array of fluid conduits are provided on an outer surface thereof with reinforcing outer sleeves.

33. The heat exchange apparatus according to Claim 32, wherein said reinforcing outer sleeves are provided in a zone within said housing, said zone being adapted to receive second fluid at a temperature of at least about 900° C.

34. The heat exchange apparatus according to Claim 33, wherein said zone is

adapted to receive second fluid at a temperature of at least about 1000° C.

35. The heat exchange apparatus according to Claim 32, wherein said reinforcing outer sleeves is made from a material that is different from a material used to form said fluid conduits of said first array of fluid conduits.

36. The heat exchange apparatus according to Claim 35, wherein a material used to form said fluid conduits of said first array of fluid conduits is selected based upon environmental conditions of the first fluid, and wherein a material used to form said reinforcing outer sleeves is selected based upon environmental conditions of the second fluid.

37. The heat exchange apparatus according to Claim 32, wherein fluid conduits of said second array of fluid conduits are provided on an outer surface thereof with reinforcing outer sleeves.

38. The heat exchange apparatus according to Claim 1, further comprising:

a first insulating layer including a first plurality of blocks of insulating material provided about an outer surface of said housing; and

a first casing provided about an outer surface of said first insulating layer.

39. The heat exchange apparatus according to Claim 38, further comprising:

a second insulating layer including a second plurality of blocks of insulating material provided about an outer surface of said first casing; and

a second casing provided about an outer surface of said second insulating layer,

wherein said second plurality of blocks of insulating material are positioned to overlap gaps between said first plurality of blocks of insulating material.

40. The heat exchange apparatus according to Claim 39, wherein said first plurality of blocks of insulating material and said second plurality of blocks of insulating material are made of insulating refractory board, and wherein said first casing and said second casing are

made of panels of galvanized sheet metal.

41. The heat exchange apparatus according to Claim 1, further comprising:

a plurality of insulating layers including blocks of insulating material provided about an outer surface of said housing; and

a casing provided about an outer surface of an outermost insulating layer of said plurality of insulating layers.

42. A method for producing hydrogen, comprising the step of:

feeding at least one fuel into a reactor comprising a housing having an inlet and an outlet, and a flow path extending within the housing from the inlet to the outlet, the flow path comprising a convectively-heated catalytic steam reformer and a convectively-cooled water gas shift reactor, whereby hydrogen is produced,

wherein a burner is provided to heat the steam reformer,

wherein combustor product from said burner is modulated by a flow diverting mechanism to maintain a predetermined operating temperature of the steam reformer,

wherein the combustion air is used to cool the water gas shift reactor before the combustion air is provided to the burner, and

wherein the combustion gas is preheated prior to being used to cool the water gas shift reactor, and wherein the combustion gas is preheated to a temperature whereby the combustion gas is provided to the burner at a predetermined temperature that is not greater than an allowable burner inlet temperature.

43. A method for producing hydrogen, comprising the step of:

feeding at least one fuel into a reactor comprising a housing having an inlet and an outlet, and a flow path extending within the housing from the inlet to the outlet, the flow path comprising a convectively-heated catalytic steam reformer and a convectively-cooled water

gas shift reactor, whereby hydrogen is produced,

wherein a burner is provided to heat the steam reformer,

wherein combustor product from said burner is modulated by a flow diverting mechanism to maintain a predetermined operating temperature of the steam reformer, and

wherein a flow passage used to carry the combustion air from an inlet of the housing to an outlet of the housing is vertically configured to allow combustion gas to exit the outlet due to buoyancy properties of heat air.

44. The method according to Claim 43, wherein the flow passage is configured to allow combustion gas to exit the outlet due to buoyancy properties of air even when the inlet is closed.

45. A method for producing hydrogen, comprising the step of:

feeding at least one fuel into a reactor comprising a housing having an inlet and an outlet, and a flow path extending within the housing from the inlet to the outlet, the flow path comprising a convectively-heated catalytic steam reformer and a convectively-cooled water gas shift reactor, whereby hydrogen is produced,

wherein fluid used to convectively heat the steam reformer and convectively cool the water gas shift reactor is modulated by a flow diverting mechanism to maintain the steam reformer at a temperature above which water can condense therein.

46. A method for producing hydrogen, comprising the steps of:

feeding at least one fuel into a reactor comprising a housing having an inlet and an outlet, and a flow path extending within the housing from the inlet to the outlet, the flow path comprising a convectively-heated catalytic steam reformer and a convectively-cooled water gas shift reactor, whereby hydrogen is produced; and

minimizing an amount of cooling fluid used to cool the water gas shift reactor using

a modulating valve to control the flow of the cooling fluid.

47. The method according to Claim 46, wherein said cooling fluid is combustion air that is provided to a burner to heat the steam reformer.

48. A method for producing hydrogen, comprising the step of:

feeding at least one fuel into a reactor comprising a housing having an inlet and an outlet, and a flow path extending within the housing from the inlet to the outlet, the flow path comprising a convectively-heated catalytic steam reformer and a convectively-cooled water gas shift reactor, whereby hydrogen is produced,

wherein a burner is provided to heat the steam reformer,

wherein a temperature of combustion product from said burner is controlled by controlling a total flowrate of combustion air to the burner, and

wherein an amount of cooling fluid used to cool the water gas shift reactor is controlled using a modulating valve to control a temperature of the water gas shift reactor.

49. The method according to Claim 48, wherein said cooling fluid is combustion air that is provided to the burner.